DOCUMENT RESUME

ED 098 738 EC 070 297

AUTHOR Tawney, James W.; Schedgick, Robert
TITLE Operant Technology Applied to the Development of Teaching Environments for Children with Severe Developmental Retardation.
INSTITUTION Kentucky Univ., Lexington.
PUB DATE Apr 74
NOTE 24p.; Best available copy; Paper presented at the Mexican Congress of Behavior Analysis (Xalapa, Mexico, April 1974)

EDRS PRICE MF-$0.75 HC Not Available from EDRS. PLUS POSTAGE
DESCRIPTORS Classroom Arrangement; Curriculum Development; *Custodial Mentally Handicapped; *Educational Technology; *Exceptional Child Education; Mentally Handicapped; *Operant Conditioning; Program Descriptions; *Programed Instruction; Sequential Learning; *Severely Handicapped; Task Performance; Teaching Methods

ABSTRACT

The authors describe an electronically programed learning environment for early education of children with severe developmental retardation which is designed to demonstrate that such children can learn when instructional variables are clearly specified and controlled. Discussed are behavioral characteristics of severaly retarded children (such as little or no vocal behavior); the layout of a programed environment classroom; the design of an automated curriculum (conceived as a common set of sequential and increasingly more complex tasks that become learner specific when performance data direct the programer to initiate an appropriate program revision strategy); the general training sequence (involving tasks such as group and pull motions); the performance of a 9-year-old child on a two-choice visual discrimination task, and the functions of the point-touch-press response in other nonautomated teacher activities and environments. Appended are diagrams of the programed environment project's learning environment, automated control system, and of the general training sequence for the automated curriculum. (LS)

ED 098738

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Operant Technology Applied to the Development of Teaching Environments for Children with Severe Developmental Retardation

BEST COPY AVAILABLE

James W. Tawney, Ph.D.

and

Robert Schedgick, Ph.D.

Programmed Environments Project
University of Kentucky
Lexington, Kentucky

Mexican Congress of Behavior Analysis
Xalapa, Mexico

April 8 - 10, 1974

BEST COPY AVAILABLE

EC 070 247

BEST COPY AVAILABLE

Operant Technology Applied to the Development of Teaching Environments for Children with Severe Developmental Retardation

ABSTRACT

Public education for children with severe developmental retardation and attendant multiple handicapping conditions is a newly established national priority in the USA. Accepting the premise that current educational practices offer little promise for the development of appropriate instructional environments for such children, a prototype training program has been developed from concepts and technology derived from an experimental analysis of behavior.

This paper describes, in brief, those social factors which have established the right to equal educational opportunity for individuals with assumed severe developmental retardation. A rationale for the application of concepts and technology derived from the experimental analysis of behavior is stated. The physical setting for a programmed preschool environment is described. Components of the solid state logic (control) system, general strategy for curriculum development based on the principle of errorless learning, and specific learning programs are described. Data is presented to illustrate that children with assumed severe developmental retardation demonstrate learning performance when careful attention is paid to systematic programming of antecedent and consequent stimulus events.

BEST COPY AVAILABLE

Introduction

Public education for children with severe developmental retardation is a newly established priority in the USA. After more than a decade of civil rights suits, and closely following judicial precedents to abolish sex discrimination, national attention has focused on discriminatory practices said to deny developmentally retarded children an equal opportunity to an education. Landmark court decisions and subsequent legislative actions have established a right to education for persons heretofore considered uneducable or nontrainable. In effect, public school systems have been directed to extend their services to a new clientele; one which historically has been relegated, or condemned, to a lifetime of institutional care. In some instances, court mandates have been quite specific; stating when, and under what conditions educational services are to be delivered. These directives have placed the schools in an untenable position; liable for failure to comply but without an educational philosophy, curricula, or personnel to initiate programs of instruction, and without the knowledge of either the educational management strategies for, or the behavioral characteristics of persons with severe developmental retardation which might provide a basis of educational planning. To complicate matters, schools have had few places to turn for direction. Their most likely resource, the field of special education, appears to have little to offer with respect to a documented, empirical basis for curriculum development (Cain and Levine, 1963; Guskin and Spicker, 1968; Kirk, 1964). As Bijou (1972) has noted, approximately 75 years have passed without positive results from special education practices.

BEST COPY AVAILABLE

Tawney (1972a) has suggested that the development of appropriate educational interventions for the severely developmentally retarded must be approached as a multi-dimensional problem. He indicated that a major problem has been the tendency of special educators to misapply an inadequate curricula developed for one population to meet educational demands for another group, e.g., curricula for normal children were modified (watered down) for educable retarded children without notable success. These modified curricula were revised again when parents pressed for equal educational opportunities for their trainable retarded children. Predicting that another repetition of this process would not yield an effective curricula for severely retarded persons, Tawney (1972a) suggested that principles and practices derived from an experimental analysis of behavior might be a more likely source for an instructional technology.

This paper describes a prototype learning environment whose design has been drawn from a functional analysis of retarded development (Bijou, 1966), antecedents for programmed or prosthetic environments, Allyon and Azrin, (1968), Ferster and DeMeyer, (1965), Bijou, Bimbrauer, Kidder and Tague (1967), Lindsley (1964), Ulrich, Louisell, and Wolfe (1971), Screven, Straka, and LaFond (1971) and a technology for designing learning sequences to minimize errors, Bijou, (1968), Sidman and Stoddard (1966, 1967), Tawney, (1972b), Terrace, (1967). The immediate goal of the project described here is to develop an electronically programmed environment for early (preschool) education for children with severe developmental retardation and attendant multiple handicaps, and to demonstrate that such children can learn when instructional variables are

BEST COPY AVAILABLE

clearly specified and controlled. The long range goal is to develop an instructional technology which will stimulate rather than retard development of persons born with observable biological defect. To accomplish these goals, the methodology and instrumentation from laboratory studies of operant behavior are being utilized to design curricula and learning environments. The products which result may be called programmed or prosthetic environments and curricula, designed to be used in home and community settings, and most definitely considered as alternatives to institutionalization.

Behavioral Characteristics of Subjects

This project, Programmed Environments for the Developmentally Retarded, enrolls children who are commonly called severely retarded, and are considered to function at a lower level than children called "educable" or "trainable" in the USA. The behavioral characteristics have been described by Tawney, (1972a, p.i) and include:

a) little or no vocal behavior

b) limited motor/gestural behavior

c) limited self-help skills

d) inconsistent or no bowel or bladder control

e) no obtained score on a standarized test of intelligence because such children are considered nontestable or because, when tested, they do not respond in a reliable manner

f) limited social interaction with other children and adults

g) inability to follow simple commands

h) no reciprocal social reinforcement of others

BEST COPY AVAILABLE

i) a high rate of stereotyped behavior

j) a high rate of disruptive social behavior

k) a low rate of behavior that might generally be called "constructive play behavior"

The Design of a Programmed Learning Environment

The Programmed Environment preschool is located in a building which has been renovated for this project, and which might be considered adequate, though not ideal. The general layout of the classrooms is shown in Figure 1. Children receive instruction in the learning booth, and in two classroom areas. Presently a six station learning carrel is being installed in the largest classroom area. The remainder of the area is used for support systems for research and development activities.

Insert Figure 1 about here

Figure 2 presents a diagram of the automated enviornment. The control center is adjacent to the learning booth. The human test console is capable of presenting auditory and visual stimuli, and converting gross or fine motor and vocal responses into electronic pulses. The classroom carrels consist of six (three finished sections) response panels with visual and response training possibilities.

Insert Figure 2 about here

BEST COPY AVAILABLE

The Design Process for an Automated Curriculum

Design of an automated curriculum for an instructional technology proceeds in a much different manner than traditional educational curriculum development. The educator generally begins his task with some new approach to his area of instruction, e.g., a theoretical rationale for a new math or "better" strategy for teaching reading. Parameters of the scope and sequence of his curricula are fairly well defined by tradition, grade level, or task determined sequential skill development. The product of his endeavors is designed for a population with a presumed common set of attributes, in a standard environment. General directions, in the form of a teacher's manual, are provided to structure teaching interactions so that the product may be used most effectively. The learner's entry behavior is assumed, as is some average time to completion of a unit of instruction.

In contrast, an automated curriculum is designed as an integral component of a precisely engineered learning environment. While environmental design is learner specific, the curriculum is conceptualized as a common set of sequential and increasingly more complex tasks that become learner specific when performance data direct the programmer to initiate an appropriate program revision strategy. At each stage or step in the curriculum, prerequisite skills of the learner are stated and documented as a condition for entering the program. Instructional variables are stated in behavioral terms, e.g., given n responses within y time parameter, modify stimulus dimension by i increments.

BEST COPY AVAILABLE

The "scope and sequence" of the automated curriculum are determined by an analysis of the behavioral attributes of the target population, assumptions concerning requisite fine grain programming techniques to build behavioral repertoires, machine and equipment limitations, and projections for the terminal point of the curriculum. Thus, the curriculum is designed for children with an extremely limited behavioral repertoire; whose first instructional tasks are adaptation to a learning environment and systematic response shaping (repertoire building). The current end-point for the curriculum is unspecified but generally assumed to be complex concept development activities which will prepare the learner to successfully engage in preacademic and traditional academic behaviors.

Automated curriculum development is predicated on the assumption that the only limits on full realization of human potential are those imposed by observable and permanent biological defect and by a rudimentary instructional technology; a position derived from Bijou's (1966) analysis of retarded development and from Skinner's (1968, p. 226) analysis of the state of an instructional technology.

One goal of this project is to design a curriculum which will enable a learner to progress, in an error-free manner, through a set of learning tasks which will literally build a behavioral repertoire which is nonexistent at the outset. The sequence of instruction is derived from a history of experimentation in human and infrahuman learning (Ferster and Skinner, 1957; Sidman and Stoddard, 1966, 1967; Moore and Goldiamond, 1964; Terrace, 1963a, 1963b; Bijou, 1968; Rosenberger, Stoddard, and Sidman, 1972; Berger, 1972). These experiments suggest a hierarchy of increasingly more complex learning tasks

BEST COPY AVAILABLE

which may be considered a sequential curriculum. A basic set of tasks (curriculum) has been written, and data is being collected on child performance at specific levels within the curriculum. Curriculum revision is based on empirical validation, a process which will transform an hypothesized curriculum into a data based sequence of instruction.

Insert Figure 3 about here

The general training sequence is presented in Figure 3. The response training section involves tasks which train such specific behaviors as grasp and pull motions, pressing, pointing and touching with one finger, and moving an arm from left to right or right to left. The stimulus control section is designed to establish simple responses to varying complex and auditory stimuli. The reinforcer evaluation section was designed to identify effective reinforcers for the child who is difficult to motivate. The other sections contain tasks which teach complex visual and auditory stimulus discriminations such as those reported by Bijou, (1968); Rosenberger, Stoddard, and Sidman (1972); Sidman and Stoddard, 1966); Berger, (1972). The generalization section is included to insure responses will occur under different environmental conditions. Finally, rentention tasks are designed to evaluate instructional effectiveness and efficiency over long periods of time.

BEST COPY AVAILABLE

TABLE 1

Component	Specific Tasks
1. Response training	a. right-left and left-right motion b. hand pressing c. grasp and pull movement d. point-touch motion with one finger e. horizontal/vertical and vertical/horizontal f. grasp and pull down
2. Reinforcer evaluation	a. reinforce preference for M&M candies or social praise b. use of repeated reinforcement and extinction procedures to establish a reinforcer hierarchy
3. Stimulus control	a. general two-choice discrimination program with correction/non-correction and fading procedure b. Multi-FR EXT with Visual/Auditory stimuli c. schedule of reinforcement- 0 -Ratios
4. Memory Training and Visual Training	
5. Auditory training - operant conditioning Audiometry for:	a. pure tone (900 Hz-3300 Hz) and O db to = 70 db b. acoustic sounds

Description of Child Performance on Automated Curriculum Tasks

All the children in the project have received instruction via the automated equipment. This section describes examples of programming sequences.

A two-choice visual discrimination task was taught to a nine year old child, S-J.R. Table 2 presents the training sequence and J.R.'s performance on the tasks.

TABLE 2

TRAINING SEQUENCE, PERCENT CORRECT FOR S-J.R.

Session	Treatment Description	Total Responses	Percent Correct
1	rate building	0	
2	"	0	
3	"	0	
4	prompt I	0	
5	"	11	
6	"	15	
7	"	14	
8	shaping I	7	
9	"	7	
10	"	7	
	(shaping II procedures introduced)		
11	universal lever	17	
12	"	11	
13	"	4	
14	"	17	
15	"	49	
16	"	72	
17	palm press	11	
18	"	28	
19	"	67	
20	single button	33	
21	"	41	

BEST COPY AVAILABLE

TABLE 2 Con't.

Session	Treatment Description	Total Responses	Percent Correct
22	recessed button	25	
23	"	39	
24	"	52	
25	single push button	46	
26	2 buttons	38	
27	"	39	
28	"	54	
29	rate building*	46	
30	pretest #1 with S^d/S^Δ		42
31	"		34
32	"		40
33	"		43
34	shaping with S^d		78
35	"		50
36	"		50
37	prompt with S^d		72
38	"		46
39	"		80
40	shaping with S^d		80
41	correction procedure with S^d		86
42	non-correction procedure with S^d		82

* met minimum rate requirement of 30 responses per session

BEST COPY AVAILABLE

TABLE 2 Con't.

Session	Treatment Description	Total Responses	Percent Correct
43	pretest #2 with S^d/S^Δ		29
44	"		28
45	"		39
46	"		41
47	S^d with 1/2" S^Δ		58
48	"		70
49	"		80

BEST COPY AVAILABLE

BEST COPY AVAILABLE

The purpose of the first sessions (rate building) was to establish a high rate of responding. During the first three sessions S slapped or hit at an illuminated stimulus panel which contained no visual stimuli. No assistance was provided to S, and no correct responses were recorded.

The condition, prompt I, was introduced in sessions 4-7. During this condition, S's incorrect responses were corrected when E guided S's hand to the lighted stimulus panel. The condition, shaping I was introduced in sessions 8-10, after S failed to establish a point-touch-press response in the prompt I condition. During shaping I, a reinforcer was presented by E, for movements which approximated the point-touch-press response. As shown in Table 2, these procedures were ineffective in establishing rate building to a defined criteria, 30 unassisted responses in a fifteen minute session. Response shaping procedures were begun in session 11. S was physically assisted to lift her arm and move a universal lever, a manipulandum which triggers a switch closure when hit from any position. In addition, S was placed on a mild food deprivation program which required that her parents bring her breakfast to school where it was fed to her contingent upon correct responding during the training session. Her rate of responding increased under these procedures, reaching 72 responses in session 16. Since the increase could be attributed to the change in procedure or the reinforcer, the deprivation schedule was terminated after session 16. A palm press manipulandum was introduced in session 17, changing the task requirement to a firm lift-press movement. After three sessions, a single small push button replaced the larger palm switch. S continued to emit the lift-press motion, triggering the button with a push with the palm of her hand. The button was then recessed

BEST COPY AVAILABLE

behind the panel which held it, requiring S to use a point movement with a single (index) finger to complete the response chain. The response was established in three sessions, and maintained in one session with the button in its original position. A second button was added to the response panel, and in three sessions S demonstrated an alternation point-touch-press response, reaching a rate of 54 responses in session 28. The lighted response panel was reintroduced in the next session, and S emitted 46 responses, exceeding criterion for rate building and enabling her to enter the visual discrimination segment of the teaching program.

S was pretested in sessions 30 - 33. The stimuli for the visual discrimination task, a red 2 1/2" x 2 1/2" cross (S^d) and a 2 1/2" diameter green circle (S^Δ), were projected on the lighted response panel. S's responding was near chance during these sessions. A shaping procedure was implemented during sessions 34-36, and S was reinforced for responses with only the S^d present. This procedure failed to bring S to the stated criterion (80% correct responding) and S was prompted during the next three trials by physically guiding her hand to complete a point-touch-press response to the S^d, if she attempted an incorrect response. Criterion was met in session 39, and maintained through three subsequent sessions under different conditions with the S^d present. A second pretest was administered and S failed to maintain criterion performance in sessions 43-46. In session 47, a fading sequence was started, with the S^d and a 1/2 circle S^Δ present. The criterion was met after three sessions. Subsequently, beginning with session 50, a 1" S^Δ replaced the 1/2" S^Δ and responding returned to chance. A variety of procedures were implemented during subsequent sessions,

BEST COPY AVAILABLE

however, stimulus control was lost each time the 1" S△ was introduced. S failed to learn the complete task, but did learn to make a two choice discrimination after learning the necessary prerequisite skills the point-touch-press movement.

Functions of the Point-Touch-Press Response in Non-Automated Environments

The utility of the prerequisite motor response can be further illustrated by a brief description of its function in other teacher activities and environments. The behavior, called a touch response, was transferred to a classroom setting by engaging S in adult-controlled teaching sessions where she was required to respond to a "Touch" command by making the point-touch-press response to (touching) a red sticker which closely approximated the size and color of the single button panel. Next, the sticker was attached to a red block, and S was instructed to "Touch Block". Subsequently, S learned to touch a specified boject in a stimulus array, enabling her to enter a language training program (Tawney and Hipsher, 1970) that teaches concepts through an errorless learning paradigm designed to allow children with little vocal behavior to demonstrate their "knowledge" of concepts through motor responses. Later still, instruction was carried out in S's home, with parents and siblings as teachers. These teaching sessions required additional and more complex motor responses, e.g., "pick up", "put in", "give me" to an array of more complex vocal commands. Her learning performance outside the programmed environment suggests transfer from more to less controlled settings and across instructional agents.

BEST COPY AVAILABLE

SUMMARY

The design of a programmed learning environment and an effective automated curriculum is a long term endeavor. The programs and data presented here describe the procedures used to translate a history of experimentation in operant behavior into an instructional (teaching) technology for children with assumed severe developmental retardation. The programmed preschool environment is a prototype, developed to accomplish two basic goals; to illustrate that technology is sufficiently developed to provide individualized daily programming for a variety of children on a daily basis; and, by so doing, to document that children with severe developmental retardation can learn when their environment is engineered to facilitate successful performance. Our preliminary developmental activities have shown that daily instruction can be provided in a controlled environment within a preschool setting, that fine grain changes in child performances can be documented; that programming strategies can be used to guide the development of adult-controlled learning programs; and in some instances, tasks learned in the programmed environment can be incorporated into adult-controlled learning activities. With the addition of a mini-computer, the prototype is being expanded to add six additional learning stations in the preschool, enabling a maximum of seven children to receive approximately six hours of daily instruction, on separate and individualized programs. The next planned strategy is to develop learning environments in home settings, where learning experiences will be controlled from the preschool environment, via a telecommunication system. These activities should be considered successive approximations to a terminal goal; the design of an educational delivery system that will enable severely retarded persons to develop complex

behavioral repertoires in programmed/prosthetic environments, beginning at birth and continuing to adulthood.

BEST COPY AVAILABLE

BEST COPY AVAILABLE

References

Allyon, T. and Azrin, N. The token economy: a motivational system for therapy and rehabilitation. New York: Appleton-Century-Crofts. 1968.

Berger, Shirley L. A clinical program for developing multimodal language responses with atypical deaf children. Language intervention with the Retarded Baltimore: University Park Press, 1972, p. 212-235.

Bijou, Sidney W. A functional analysis of retarded development . in N. Ellis (Ed.) International Review of Research in Mental Retardation, Vol. 1 New York: Academic Press, 1966, pp. 1-19.

Bijou, Sidney W. A functional analysis of retarded development. in N. Ellis (Ed.) International Review of Research in Mental Retardation, Vol. 1 New York: Academic Press, 1968, pp. 1-19.

Bijou, Sidney, W. The technology of teaching young handicapped children, Behavior Modification-Issues and Extensions, New York: Academic Press, 1972, p. 27-49.

Bijou, S., Birnbrauer, J., Kidder, J. and Tague, C. Programmed instruction as an approach to teaching of reading, writing, and arithmetic to retarded children. in S. Bijou and D. Baer (Eds.) Child development: Readings in experimental analysis. New York: Appleton-Century-Crofts, 1967, p. 309-329.

Cain, L. and Levine, S. Effects of community and institutional school programs on trainable mentally retarded children. CEC Research Monograph, Washington, D.C., 1963.

Ferster, C., and DeMeyer, M. A method for the experimental analysis of the behavior of autistic children. American Journal of Orthopsychiatry, 1962, 32, 89-98.

Ferster, C., Skinner, B., Schedules of Reinforcement. New York: Appleton-Century-Crofts, 1957.

Guskin, Samuel L. and Spicker, H. Educational research in mental retardation. in N. Ellis (Ed.) International Review of Research in Mental Retardation, Vol. 3 Academic Press, 1968, pp. 217-278.

Kirk, S.A. Research in education. in Stevens, H. and Heber, R. (Eds) Mental Retardation. Chicago: University of Chicago Press, 1964, pp. 57-99.

Lindsley, O. Direct measurement and prosthesis of retarded behavior. Journal of Education, 1964, 147, 62-81.

Lloyd, L., and Fulton, R., Audiology's contribution to communications programming with the retarded. Language Intervention with the Retarded, Baltimore: University Park Press, 1972, p. 111-129.

BEST COPY AVAILABLE

Moore, R. and Goldiamond, I. Errorless establishment of a visual discrimination using fading procedures. Journal of the Experimental Analysis of Behavior, 1964, 7, 269-272.

Rosenberger, P., Stoddard, L., Sidman, M. Sample - matching techniques in the study of children's language. Language of the Mentally Retarded, Baltimore: University Park Press, 1972, 211-229.

Screven, C., Straka, J., and LaFond, R. Applied behavioral technology in a vocational rehabilitation setting. in U. Gardner, Behavior Modification in Mental Retardation. Chicago: Aldine-Atherton. 1971, pp. 315-359.

Skinner, B.F., The technology of teaching, New York: Appleton-Century-Crofts, 1968.

Sidman, M. and Stoddard, L. Programming perception and learning for retarded children. in N. Ellis (Ed.) International Review of Research in Mental Retardation, Vol. 2, New York: Academic Press, 1966, pp. 151-208.

Sidman, M. and Stoddard, L. The effectiveness of fading in programming a simultaneous form discrimination for retarded children. Journal of the Experimental Analysis of Behavior, 1967, 10, 3-15.

Tawney, J. (a) Programmed Environments for Developmentally Retarded Children: A project for a coordinated program of research, program model development and curriculum development and dissemination. Project No. 233118 (Original Proposal), 1972.

Tawney, J. (b) Training Letter Discrimination in Four Year Old Children, Journal of Applied Behavior Analysis, 1972, 5, 455-465.

Tawney, J. and Hipsher, L. Systematic Language Instruction. Final Report, Project No. 7-1205. Washington, D.C.: United States Office of Education, 1970.

Terrace, H.S., Discrimination learning with and without "errors", Journal of the Experimental Analysis of Behavior, Vol. 6, 1, January, 1963 (a)

Terrace, H.S., Errorless transfer of a discrimination across two continua, Journal of the Experimental Analysis of Behavior, Vol. 6, 2, April, 1963 (b)

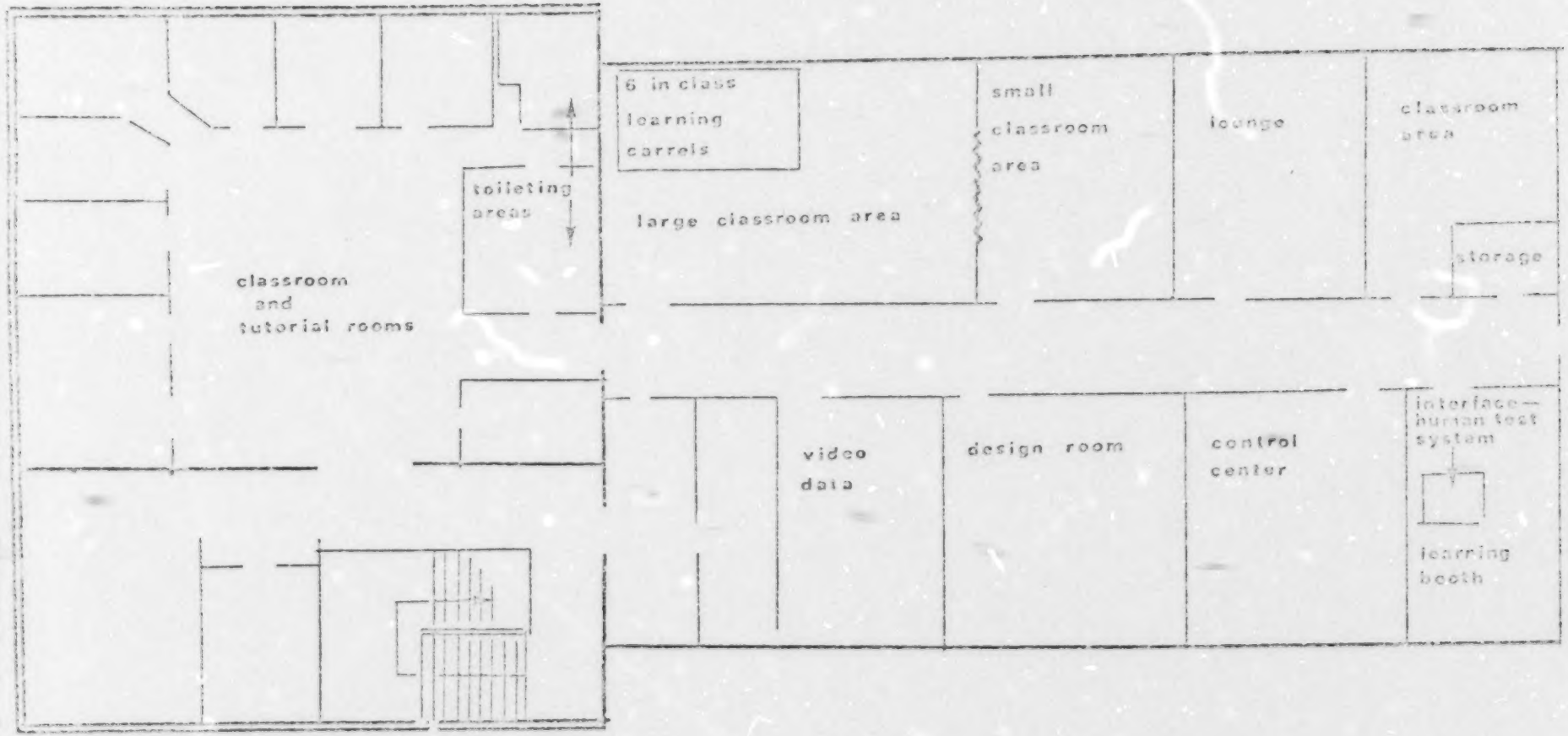
Terrace H.S. Stimulus control. in W. Honig (Ed.) Operant behavior: areas of research and application. New York: Appleton-Century-Crofts, 1967, pp. 271-344.

Ulrich, R., Louisell, S., and Wolfe, M. The learning village: a behavioral approach to early education. Educational Technology, 1971, 11(2), 32-45.

BEST COPY AVAILABLE

PROGRAMMED ENVIRONMENTS PROJECT

LEARNING ENVIRONMENT



BEST COPY AVAILABLE

FIGURE 2

Diagram of Automated Control System

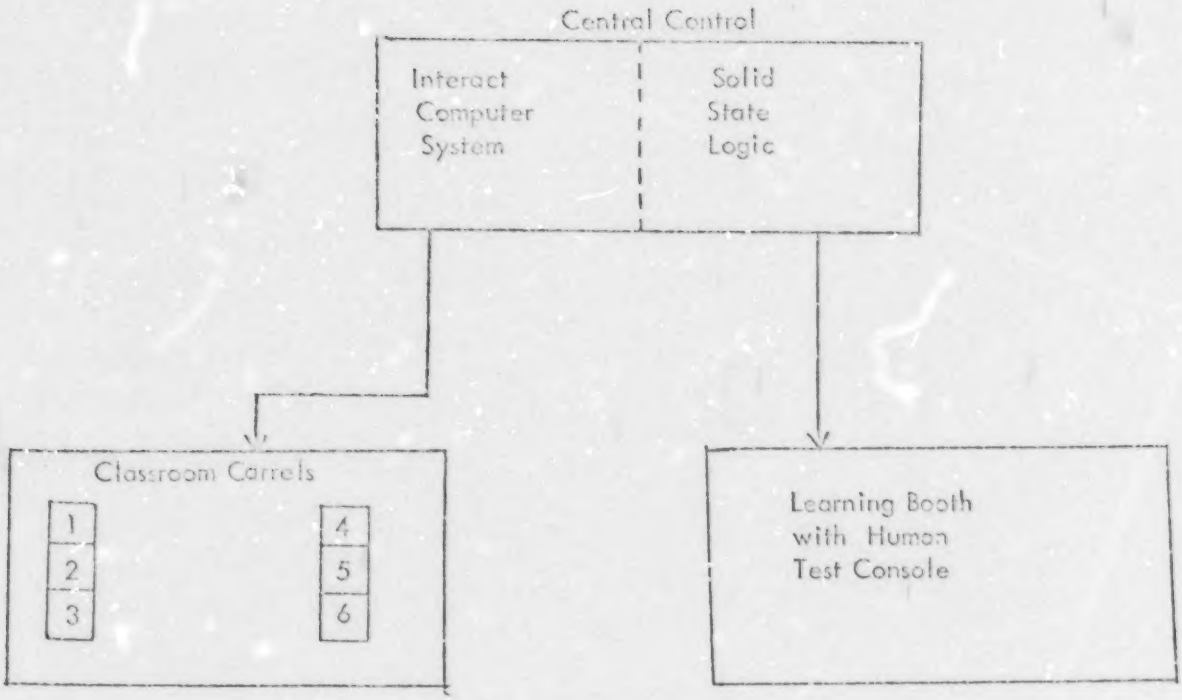
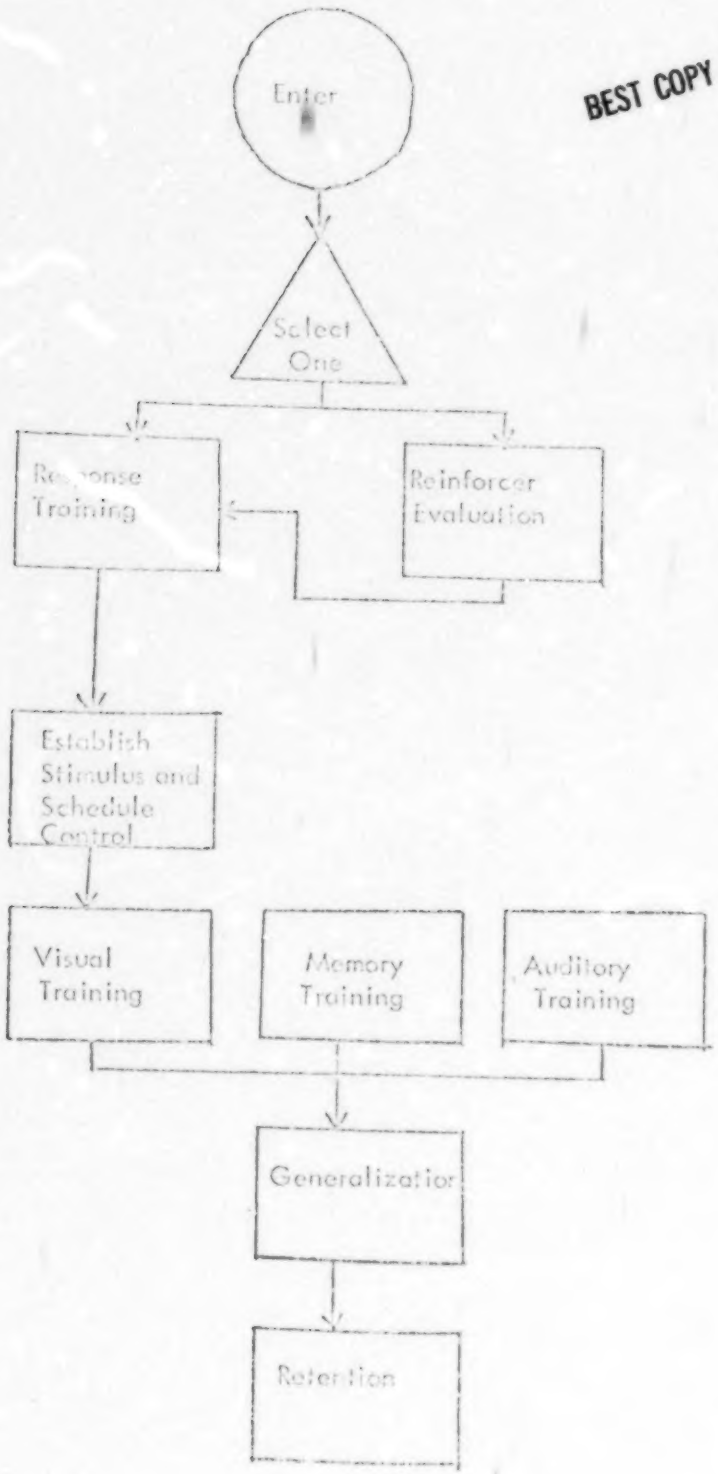


FIGURE 3

General Training Sequence for Automated Curriculum



BEST COPY AVAILABLE